

Geographical and social class effects on asthma mortality in England and Wales

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To determine whether asthma mortality is influenced by geographical or social factors, a retrospective analysis of deaths from asthma in England and Wales between 1979–1987 was performed. Death rates in the 15 Regional Health Authority areas of England and Wales were stratified by sex, age group (0–4, 5–34, 35–64, and >64 years), and occupational social class. Detailed analysis was restricted to subjects aged 5–64 years because adequate social class data was only available over this age range. Death rates were higher in manual occupational groups (social class IIIb–V) than in non-manual occupations (social class I–IIIa), but on further analysis this effect was confined to males aged 35–64 years. In younger subjects (5–34 years), mortality was higher in the south of the country, and this difference was significant in males ($P < 0.05$). In older subjects (35–64 years), mortality in both sexes was significantly higher in the north of the country. This study demonstrates that mortality is not evenly distributed between social classes or regions of the country.

Introduction

Asthma mortality has increased in many parts of the world including England and Wales (1–9), but the cause of the increase is unclear. In general terms, possible explanations would include (1) an increase in the recognition and diagnosis of asthma; (2) a true increase in the prevalence or severity of asthma brought about by as yet undefined aetiological factors; (3) inadequate treatment of asthma, a factor often identified when individual deaths are studied in detail (10–15) or (4) adverse effects of medication given for asthma, a hypothesis which has recently attracted much attention (16–19).

Any analysis of the relative importance of these factors in England and Wales should take into account geographical and social variations in asthma deaths, but the pattern of variation with these factors has generally received less attention than the temporal changes. If differences in environmental exposures are relevant then an associated regional variation in asthma mortality might be expected. If differences in treatment or diagnosis and ascertainment are relevant mortality rates might be expected to vary with social factors, as with many other diseases. Therefore we have looked at the effects of geographical and

social factors on asthma mortality in England and Wales in the years since the most recent ICD coding revision.

Methods

Mortality data for England and Wales classified by age, sex, region and social class, and mid-year estimates of the total population of each Regional Health Authority for the years 1979–1987 were obtained from OPCS. Social class distributions for the population of each Regional Health Authority were estimated from 1981 census data.

Annual death rates per million population were calculated from these data and plotted against time for both sexes, in age groups 0–4 years, 5–34 years, 35–64 years and 65 years and over. Deaths which occurred outside the U.K. were excluded from analysis. Deaths in the 0–4 years age group were so infrequent that further analysis was not possible, and no further analysis was performed in subjects over the age of 65 years since social class was rarely specified in this age group.

Social class effects were studied using two groupings representing non-manual (social classes I–IIIa) and manual (social classes IIIb–V) occupations. Annual death rates were then determined by these social class groupings for subjects aged 5–34 years and 35–64 years.

Regional effects were studied by calculating mean annual death rates by age group for each Regional

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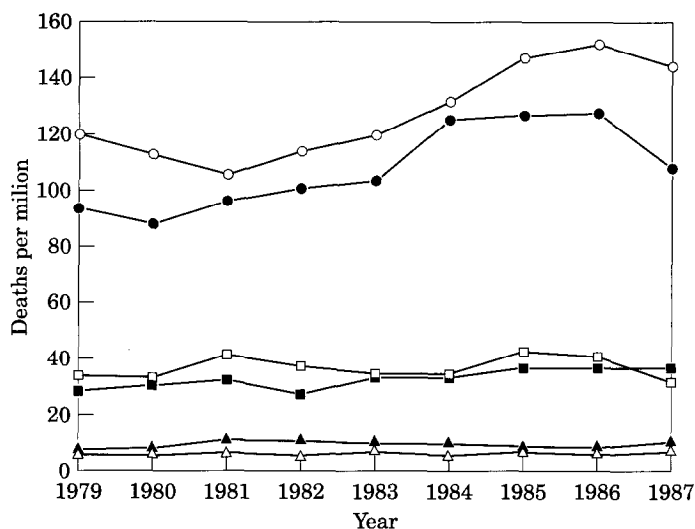


Fig. 1 Mortality rates (deaths per million population) in England and Wales 1979–1987. ▲, males age 5–34 years; △, females age 5–34 years; ■, males age 35–64 years; □, females age 35–64 years; ●, males age >64 years; ○, females age >64 years.

Health Authority. These were aggregated for further analysis into northern (comprising Northern England, Northwest England, Mersey, West Midlands, Trent, and Wales) and southern (comprising Southwest England, East Anglia, Oxford, Wessex, and the four Thames regions) areas.

To test the significance of the observed regional and social class differences and the interaction of these factors with each other, the annual mortality data was analysed by Poisson regression using the program GLIM. The effects on this model of age, region and social class, and of their interactions with each other, were determined after controlling for year of death. Separate analyses were performed for males and females because of the difference in completeness of social class data (missing in 17% of male deaths vs. 67% of female deaths). In addition, since some information was omitted by analysing only those deaths for which social class information was available, further Poisson analysis was performed comparing regional mortality for all deaths including those in which social class was not known. A probability level below 5% was taken as indicating statistical significance.

Results

TEMPORAL, AGE AND GENDER DIFFERENCES

Mortality increased slightly during the study period in both sexes, and in all age groups except those below the age of 5 years. Most deaths, and the

greatest change in mortality with time, occurred in the >64 years age group (Fig. 1). Mortality differences between males and females were age-dependent with higher mortality in males in the 5–34 years age group, and in females aged 35 years or over.

REGIONAL VARIATION

Mean death rates by region and sex for age groups 5–34 years and 35–64 years are given in Table 1 and illustrated in Fig. 2. Overall mortality was higher in the north than in the south. However, in both males and females, the higher mortality in the north was only seen in those aged 35–64 years. This difference was observed both when data for all deaths including those of unspecified social class were analysed, and when only those deaths for which social class data were available were analysed. The north–south difference remained significant after correction for social class (Table 2, $P < 0.01$ in males, $P < 0.05$ in females).

In the 5–34 years age group, there was no significant north–south difference in females, and among males mortality was actually higher in the south ($P < 0.05$), the opposite of the trend in older males.

SOCIAL CLASS EFFECTS

Overall mortality was significantly greater in the manual social class grouping. However, when the age–sex groupings were considered separately, the difference was found to arise entirely from males aged 35–64 years [mean (SD) deaths/million, 24.6 (2.2) in

Table 1 Deaths per million population by age group and sex in Regional Health Authority areas of England and Wales 1979–1987

	Males		Females	
	5–34 years	35–64 years	5–34 years	35–64 years
North	8.80	36.59	8.71	47.16
Yorkshire	7.64	34.41	6.18	37.83
Northwest	7.37	35.14	7.01	43.58
Mersey	8.96	34.77	6.26	38.59
Trent	8.52	32.61	6.84	37.45
Midlands	9.38	35.19	7.42	40.64
East Anglia	11.68	32.47	8.43	34.94
Oxford	11.06	29.60	6.31	29.96
Northwest Thames	10.72	29.37	7.58	31.92
Northeast Thames	12.25	27.68	6.55	33.15
Southeast Thames	9.94	32.23	6.35	31.45
Southwest Thames	10.42	31.74	8.05	29.47
Wessex	10.27	31.93	7.23	33.45
Southwest	10.42	34.26	6.97	34.59
Wales	8.16	34.13	4.68	46.81

non-manual occupations, 33.5 (2.2) in manual occupations]. There was no significant difference between social classes in males aged 5–34 years nor in any female age-sex group, although much social class information was not recorded in females. The mortality trends in age-social class groupings in males are illustrated in Fig. 3.

Discussion

An increase in asthma mortality in England and Wales during the last two decades has been reported previously, notably in the paper by Burney in 1986 (2), and similar increases have been observed in other countries (1,3–9). Crude mortality statistics for England and Wales since 1987 demonstrate that although asthma mortality has remained high, the progressive increase in the early 1980s described by Burney, which continued throughout the first half of the period we studied, has not subsequently been sustained (20). These temporal trends have received much attention—the principal objective of this study was to estimate social class and regional effects on mortality, since these have received relatively little consideration.

We analysed data for the period from the introduction of the 9th revision of the International Classification of Diseases in 1979 until 1987, which was the last year for which OPCS were able to make social class data available to us. The rules governing coding of cause of death were changed in 1984, but this

should not effect regional or social class comparisons.

The main findings of the study were that, aside from the secular increase in mortality during the period of the study, low socio-economic status was an independent predictor of increased asthma mortality in older males, and that regional differences in mortality were highly dependent on age, with deaths being more frequent in older age groups in the north of the country and in younger age groups in the south of the country.

Social class effects on asthma mortality have not previously been considered in the same depth as sex and temporal trends, but the association between social class and control of asthma, assessed by peak expiratory flow criteria, has been assessed, showing that asthma control was poorer in patients with manual occupations (21). Conversely, in one previous study of mortality data for England and Wales from 1974–1978 Charlton *et al.* showed asthma to be one of the few diseases in which social class indicators were not associated with higher mortality (22). The social class indicators used in that study were percentages of households without cars, rented homes, unskilled workers, and low birth weight, whereas our study used the occupational social class given on the death certificate.

On further inspection the social class difference demonstrated in this study was confined principally to males aged 35–64 years. The reasons for the absence of any social class effect in females are difficult to determine since social class data was missing in many females—the lack of so much data may in itself explain the failure to demonstrate any social class effect.

Why social class effects are more marked in older than younger males is unclear, but differences in prevalence, diagnostic ascertainment of asthma and diagnostic transfer from other categories of obstructive airways disease may all contribute to this effect. Among children the prevalence of all self-reported wheezing is higher in lower social classes (23,24), whereas studies of the prevalence of self-reported asthma are contradictory with some finding asthma to be more frequent in higher socio-economic groups (25,26) whilst other studies refute this (27–30). Thus it appears that in children the underlying prevalence of wheezing illness is increased in lower social classes, but the acquisition and reporting of asthma as a diagnostic label for this illness may be more frequent in higher social classes. In younger age groups therefore, the contrasting effects of true prevalence and diagnostic ascertainment may balance out, resulting in relatively little net difference in asthma mortality between social class groups in the 5–34 years age



Fig. 2 Average mortality rates by region for England and Wales. (a) males age 5-34 years; (b) females age 5-34 years, (c) males age 35-64 years; (d) females aged 35-64 years; shaded areas, four regions with highest mortality; lined areas, above average mortality; dotted areas, below average mortality; and unshaded areas, four regions with lowest mortality.

group. In older populations however, the prevalence of all wheezing illness is increased substantially by the emergence of smoking-related chronic obstructive airways disease. Thus the potential for appreciable diagnostic misclassification and transfer from chronic airflow obstruction to deaths attributed to asthma is much higher in older age groups. Our finding of increased mortality in older males in manual occupations may therefore reflect a diagnostic transfer effect. Alternatively, the prevalence of asthma may

be genuinely increased in manual social classes, perhaps reflecting adverse effects of occupational exposures.

Most studies of geographical variation in asthma mortality have concentrated on the large differences between countries (1,31,32), with regional variation within countries receiving relatively little attention. Recent studies have demonstrated mortality differences between regions of the U.S.A. (33,34), the areas of higher mortality varying between racial groups

Table 2 Effects of age, social class and area of residence on mortality from asthma

	Males	Females
	Coefficient (SE)	Coefficient (SE)
Addition for age group 35–64 years	1.536 (0.113)***	1.519 (0.093)***
Addition† for residence in north in age group 5–34 years	–0.192 (0.096)*	Not significant
Addition for residence in north in age group 35–64 years	0.257 (0.094)**	0.290 (0.140)*
Addition for manual social class in age group 35–64 years	0.385 (0.096)***	Not significant

* $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$; †negative coefficient: higher mortality in south in this age group. All coefficients are relative to a 'baseline' group of those aged 5–34 years, non-manual social class, resident in the south. Coefficients (SE, standard error) are derived from Poisson regression equation controlled for year effects and including age, social class, and area of residence, and all possible interactions between these 3 factors. Only significant coefficients are shown.

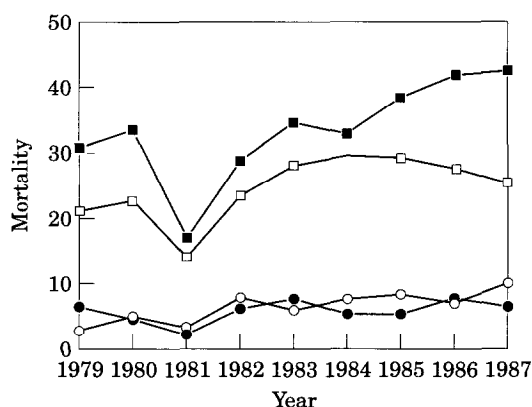


Fig. 3 Mortality rates (deaths per million) by social class for males in England and Wales 1979–1987. ○, non-manual social class age 5–34 years; ●, manual social class age 5–34 years; □, non-manual social class age 35–64 years; ■, manual social class age 35–64 years. The apparent drop in mortality in 1981 is the result of industrial action at OPCS leading to a failure to code social class in that year.

(35). However, the cause of this variation remains uncertain.

In England and Wales regional mortality rates vary in many diseases but the pattern demonstrated for asthma in this study is unusual. In the 35–64 years age group mortality was higher in the north, but in males aged 5–34 years the trend was reversed with higher mortality in southern regions. The excess mortality in the older age group in the north was not explained by allowing for the higher proportion of people in manual social class groups. This pattern of regional variation is not consistent with a single environmental aetiological exposure.

Differential treatment effects are possible, but although marked variation in treatment of children between health districts of a single Regional Health Authority have been demonstrated (36) it seems unlikely that this would occur to the same degree at an inter-regional level. Furthermore, regional differences in use of medications and of health care services in general would be expected to affect all age groups equally. Regional differences in prevalence of wheezing in British children have been demonstrated, but this had become negligible in age groups of 23 years and above (37). In a separate study of selected health districts around England and Wales there was considerable variation in hospital admission rates for asthma around the country among subjects aged 20–44 years, and also differences in prevalence of self-reported asthma and respiratory symptoms which the authors believed explained a substantial part of the variation in admissions (38). Therefore, prevalence differences might partially explain our findings. A relatively high prevalence of smoking in northern regions (39) may also have contributed, through diagnostic transfer from chronic obstructive airways disease, to the increased mortality in older age groups in the north.

Therefore, the principal findings of this study are that mortality rates for the period 1979–1987 were generally higher in subjects aged 35–64 years living in the north of the country, and in males aged 35–64 years of manual occupational social class. The extent to which these effects are causally related to asthma, or are confounded by diagnostic transfer from smoking and occupationally-related obstructive airways disease, remains to be established.

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